

## Animal Hormones Affecting Growth and the Several Effects of Single Hormones\*

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In higher vertebrate animals and man, the forms in which hormonal regulation is best known, several hormones act as stimulants to growth. In some cases this stimulus is fairly restricted or localized and only a single function or special tissue is affected. But advancing information indicates that many hormones affect a variety of functions and organs. For higher animals it has been learned during the past 15 years that the center of hormonal regulation resides in the anterior pituitary gland; its hormones may be called "trigger" hormones. In large measure these "trigger" hormones stimulate other hormone producing glands (thyroid, gonad, adrenal) whose products may thus in turn be called "target" hormones (thyroxine, estrone, testosterone, cortin). Growth processes are affected by both "trigger" and "target" hormones; one of the former, prolactin, and one of the latter, estrone (or estrogens), are here utilized as illustrations of hormones which are not only related to growth but which also exhibit a variety of actions.

Prolactin stimulates milk secretion in mammals and growth of crop-sacs and production of crop-milk in pigeons. It sometimes reduces or prevents the secretion of the "trigger" hormone, gonadotrophin. It releases broodiness (fowl, pigeon) and maternal behavior (rats). Perhaps it prolongs the life of corpus luteum cells, and stimulates their production of the hormone, progesterone. In pigeons, but not in rats, it seems to be the chief and best of hormones for the promotion of bodily growth. It assists growth in dwarf mice and there synergizes the action of thyrotrophin on growth. In pituitaryless pigeons prolactin can increase body weight and intestinal and liver tissue to an extraordinary degree, and likewise it can partially support the pancreas; but all these actions can be shared or augmented by hormone of the adrenal cortex (unpublished, Miller and Riddle), while still a third hormone, thyroxine, further assists in maintaining the weight of the intestine and pancreas. It is a moot question whether the pituitary gland produces a single "growth hormone" or whether bodily growth (probably somewhat differently stimulated in different species) is a summation of effects of various "trigger" and "target" hormones.

Estrone, or stable estrone-like substance, has been obtained from yeast, rape seed, potatoes and female willow catkins—even from petroleum and lig-

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nite. Estrone produces localized growth in oviduct, mammary glands and uterus. It reduces or suppresses the output of the pituitary hormone, gonadotrophin. It affects bone development and general bodily form in some species. It has an action on the calcium, phosphorus and fat of the blood. In the mental sphere it affects sex behavior.

The past 15 years of study of the actions, interactions and automatic control of release of the pituitary hormones in the bodies of higher animals have provided a purely natural basis for some of the most mysterious performances and adjustments of our own bodies. Now, for the first time in the long history of man, human beings partly know a series of organs and substances which—acting in high degree as a self-regulating system—largely control the fuller expression of growth, the rhythms of reproduction, and some aspects of temperament and behavior. In short, we have come to recognize our anterior pituitary gland as the master or governing gland; also, the brain and this master gland are now marked as the two truly basic sources of the strength and competence of man. It should arouse biologist and layman alike to reflect that up to our own time mankind has made its whole history—its conquests, its arts, its literature, its laws, its religions, its philosophies—while wholly ignorant of one of the two physical sources from which the abilities of an individual human being are derived.

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